Shelfbreak Frontal Dynamics in the Middle Atlantic Bight: Analysis of Seasoar Data from the Shelfbreak Primer Experiment

Glen G. Gawarkiewicz
Department of Physical Oceanography, MS #21
Woods Hole Oceanographic Institution, Woods Hole, MA 02543
phone: (508) 289-2913 fax: (508) 457-2181 email: glen@oldtown.whoi.edu

Kenneth H. Brink
Department of Physical Oceanography, MS #21
Woods Hole Oceanographic Institution, Woods Hole, MA 02543
phone: (508) 289-2535 fax: (508) 457-2181 email: kbrink@whoi.edu

Robert C. Beardsley
Department of Physical Oceanography, MS #21
Woods Hole Oceanographic Institution, Woods Hole, MA 02543
phone: (508) 289-2536 fax: (508) 457-2181 email: rbeardsley@whoi.edu

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LONG-TERM GOALS

Our long-term goals are to establish a dynamical framework for understanding shelfbreak fronts and the processes which contribute to temporal and spatial variability, particularly along-front variability. We are also interested in the implications of the variability for sound propagation between the continental shelf and slope.

OBJECTIVES

We wish to establish how various forcing processes such as offshore eddies and wind forcing affect the front and its associated frontal jet. We also wish to establish the temporal variability of dynamically significant parameters such as the relative vorticity and potential vorticity, and examine how these vary temporally under different extremes of seasonal stratification.

APPROACH

We have been analyzing the data in a variety of contexts. We have been cross-comparing moored velocity data with shipboard velocity data to establish proper referencing of geostrophic velocities. We are presently examining the effects of more complicated dynamics due to flow curvature on the estimated low-frequency velocity fields. We also have been collaborating with other Shelfbreak PRIMER investigators on topics including internal tide generation, sound propagation, frontal stability analysis, and data-assimilative numerical modelling.

WORK COMPLETED

During the past year, we completed work on the interaction of a small slope eddy interacting with the shelfbreak front during the spring PRIMER cruise, calculated temporal and spatial decorrelation scales for the different seasons, and completed analysis of internal tide generation (Colosi *et al.*, 2000) as well as a linear stability analysis of the front using realistic horizontal and vertical velocity shears. We also completed some collaborative work with PRIMER acousticians concerning the seasonal aspects of sound propagation through the PRIMER site (Newhall *et al.*, 2000).

RESULTS

The results we have obtained this past year highlight the extreme alongfront and temporal variability within the vicinity of the shelfbreak front. The spring cruise showed large alongfront variability of the front due to the presence of a small (25-km diameter) slope eddy immediately offshore of the front (Gawarkiewicz *et al.*, 2000). The interaction of the eddy with the front resulted in substantial alongfront accelerations and decelerations of the frontal jet depending on the eddy proximity. Analysis of spring, summer, and winter conditions shows time scales on the order of one day and length scales of order 10 km for decorrelation scales. A linear stability analysis of the front using observed PRIMER scales was successful at producing growth rates for frontal waves on a comparable time scale to that of the observed variability (Lozier *et al.*, 2000). Analysis of the summer PRIMER data set shows strong alongfront variations in the shape of the front and the maximum jet velocity which are due to both the propagation of a frontal meander through the study region as well as interaction with a slope eddy located further offshore.

IMPACT / APPLICATIONS

The results we have obtained to date have been important in understanding the alongfront variability of the shelfbreak front, in particular alongfront accelerations and decelerations. We have also shown how daily variations in the frontal jet affect the formation of internal solitary waves. The linear stability analysis is useful in establishing parametric understanding of how various frontal jet parameters, such as maximum jet velocity and jet width, affect growth rates in different shelfbreak frontal systems. The collaborative work with the acousticians has been useful in understanding the variability of the sound propagation between the continental slope and shelf on a variety of time scales, which is important in sonar system performance in the littoral zone.

TRANSITIONS

Results from the Summer PRIMER program were used in the Capturing Uncertainty DRI to study the effects of environmental variability on sonar system performance.

RELATED PROJECTS

1. The ASIAEX Volume Interactions Program is looking at shelfbreak processes within the South China Sea, a low-latitude, highly-stratified shelfbreak environment. We have collaborated on fieldwork with investigators from National Taiwan University to obtain high-resolution hydrography near Dongsha Island in the South China Sea.

2. We are looking at shelfbreak exchange processes in the Arctic Oceans as part of the Shelf-Basin Interactions initiative (in collaboration with D. Chapman of WHOI).

3. Gawarkiewicz is interacting with J. Lynch and J. Colosi of WHOI to quantify thermal and soundspeed variability as part of the Capturing Uncertainty DRI.

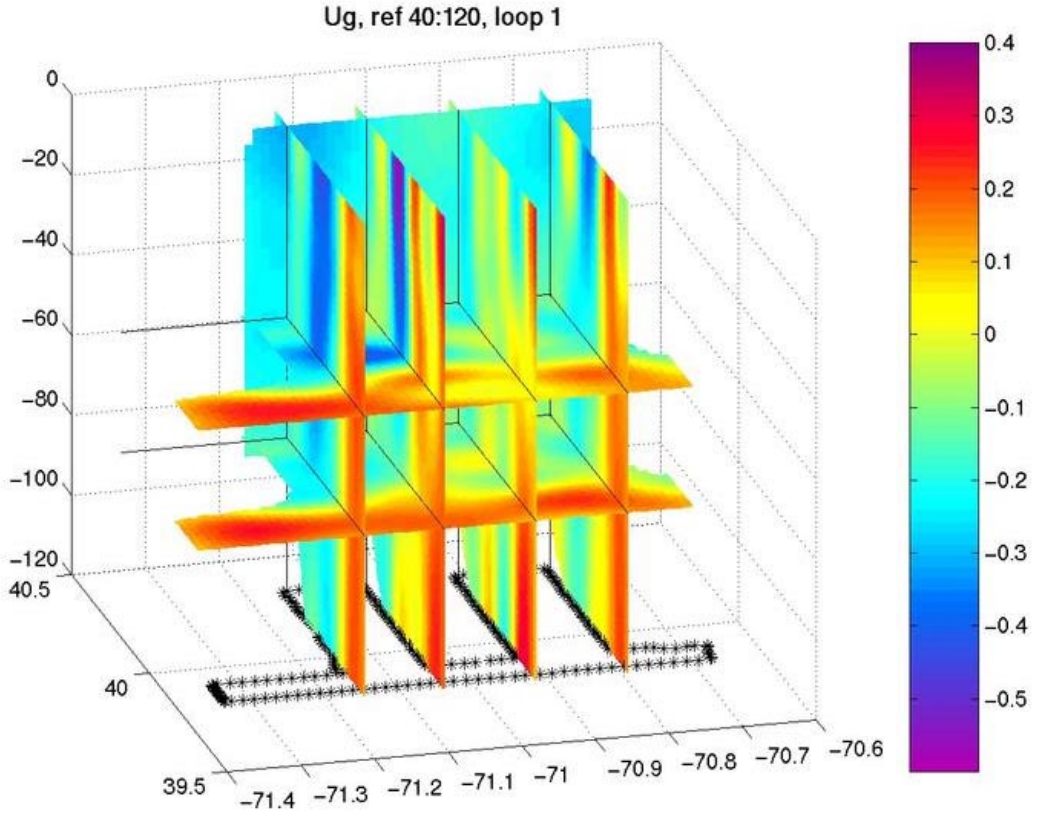

Figure 1: A view of the three dimensional structure of the alongshelf (eastward) velocity from the summer PRIMER experiment. Note the strong westward velocities in the shelfbreak frontal jet, which has maximum velocities over 0.5 meters/second. There are strong eastward flows offshore of the frontal jet, with velocities of 0.2 meters/second or larger. The view here is northward (onshore), and the x and y axis are the longitude and latitude in decimal degrees, while the z axis is depth in meters.

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Newhall, A., B. Sperry, J. Lynch, G. Gawarkiewicz, and C.-S. Chiu, 2000. Spatial and temporal variations in acoustic propagation characteristics at the New England shelfbreak front. *IEEE Journal of Oceanic Engineering*, submitted.

PUBLICATIONS

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